PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-026685
(43)Date of publication of application : 25.01.2002

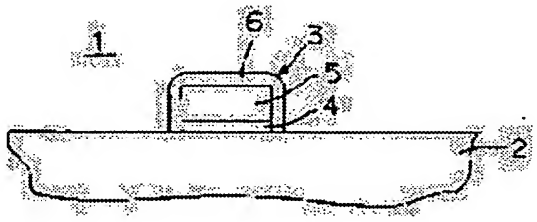
(51)Int.Cl. H03H 9/145
H03H 3/08

(21)Application number : 2000-206253
(22)Date of filing : 07.07.2000

(71)Applicant : MURATA MFG CO LTD
(72)Inventor : WATANABE MASANOBU
INOUE KAZUHIRO

(54) SURFACE ACOUSTIC WAVE ELEMENT

(57)Abstract:
PROBLEM TO BE SOLVED: To solve problems of a conventional surface acoustic wave element that has had deteriorated adhesiveness between electrodes and a piezoelectric substrate and has caused a material Cu employed for the electrodes to be susceptible to oxidation when the Cu is employed for the electrodes formed on the piezoelectric substrate in order to improve the power resistance.
SOLUTION: After forming a 1st electrode layer 4 made of Ti or a Ti alloy on a piezoelectric substrate 2, a 2nd electrode layer 5 made of Cu or a Cu alloy is formed on th 1st electrode layer 4. Then a 3rd electrode layer 6 made of Al or an alloy whose principal component is Al or made of Au or an alloy whose principal component is Au is formed to cover an upper face and side faces of th 2nd electrode layer 5.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]

[Claim 1] It is a surface acoustic element equipped with the 2nd electrode layer which is a surface acoustic element equipped with a piezo-electric substrate and the electrode formed on the aforementioned piezo-electric substrate, and consists of Cu or Cu alloy formed on the 1st electrode layer which consists of Ti or Ti alloy with which the aforementioned electrode is formed on the aforementioned piezo-electric substrate, and the electrode layer of the above 1st.

[Claim 2] The aforementioned electrode is a surface acoustic element according to claim 1 further equipped with the 3rd electrode layer for suppressing oxidization of Cu formed on the electrode layer of the above 2nd.

[Claim 3] The electrode layer of the above 3rd is a surface acoustic element according to claim 2 formed so that the upper surface and the side of an electrode layer of the above 2nd may be covered.

[Claim 4] The electrode layer of the above 3rd is a surface acoustic element according to claim 3 formed by the sputtering method.

[Claim 5] The thickness of the electrode layer of the above 2nd is a surface acoustic element according to claim 2 to 4 which are 40% or more of total thickness Mino of the aforementioned electrode, and 80% or less.

[Claim 6] The electrode layer of the above 3rd is a surface acoustic element according to claim 2 to 5 which consists of an alloy which makes a principal component the alloy, Au, or this which makes aluminum or this a principal component.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to a surface acoustic element equipped with the electrode which has the high power-proof nature suitable for using as for example, an antenna duplexer especially about a surface acoustic element.
[0002]
[Description of the Prior Art] Surface acoustic elements are the electronic parts which used the surface acoustic wave which mechanical oscillation energy concentrates only near a solid-state front face, and spreads as everyone knows, generally are constituted with the piezo-electric substrate which has piezoelectric, and an electrode like the interchange digital transducer (IDT) electrode for impressing a signal formed on this piezo-electric substrate, and are used as a filter or a resonator.
[0003] In such a surface acoustic element, as an electrode material, electrical resistivity is low and it is common to use aluminum system alloy which makes a principal component aluminum or aluminum with small specific gravity.
[0004] In recent years, development of mobile communication terminals, such as a miniaturization and a cellular phone which turned lightweight, is furthered quickly. Therefore, in order to call for the miniaturization of the parts used for these mobile communication terminals and to contribute to the miniaturization of the RF section (radio frequency head), constituting a resonator, an interstage filter, a duplexer, etc. by the surface acoustic element is performed. Since the surface acoustic element which serves as an antenna duplexer also in these is located in the front end section of the RF section, high power-proof nature is required.
[0005] In addition, while also RF-izing the frequency of operation of a surface acoustic element from hundreds of MHz to several GHz with RF-izing of mobile communications, a high increase in power is desired. Detailed-ization of the pattern width of face of an IDT electrode is needed, and it is necessary to form electrode line breadth in about 0.5 micrometer with the 2GHz band filter of center frequency by RF-ization.
[0006] However, if the signal of high-voltage level is impressed to the IDT electrode which has line breadth detailed as mentioned above, an IDT electrode will receive strong stress by the surface acoustic wave. If this stress exceeds the

critical stress of an electrode layer, a stress migration will occur. Since it is a stress migration when aluminum is used as an electrode material as mentioned above, aluminum atom moves the grain boundary, a hillock and a void occur in an electrode, therefore an electrode breaks, and it results in property degradation of surface acoustic elements, such as **, an electric short circuit and the increase in an insertion loss, and Q fall of a resonator, soon.

[0007] In order to solve such a problem, using Cu is indicated by JP,9-98043,A and JP,9-199976,A in the electrode formed on the piezo-electric substrate.

[0008]

[Problem(s) to be Solved by the Invention] However, there is a problem that corrosion resistance is [that it is easy to oxidize] inferior in Cu. Moreover, as for the electrode constituted with Cu, adhesion with a piezo-electric substrate also has the problem of being bad.

[0009] In the official report mentioned above, although carrying out little addition of the metals, such as Zn, is indicated in order to raise the oxidation resistance and corrosion resistance of Cu, as such a cure, the oxidation resistance and corrosion resistance of Cu cannot fully be raised.

[0010] Moreover, although aiming at improvement in adhesion with a substrate by carrying out little content of the silicon to Cu is indicated by JP,9-98043,A, the problem that the effect is not enough, for example, an electrode separates from a substrate at the time of wirebonding may be encountered.

[0011] Then, the purpose of this invention is offering the surface acoustic element which can solve a problem which was mentioned above, though Cu is used in an electrode.

[0012]

[Means for Solving the Problem] This invention is characterized by to have the 2nd electrode layer which consists of Cu or Cu alloy with which an electrode is formed on the 1st electrode layer which consists of Ti or Ti alloy formed on a piezo-electric substrate, and the 1st electrode layer in order to solve the technical technical problem equipped with a piezo-electric substrate and the electrode formed on this piezo-electric substrate which it is turned to a surface acoustic element and mentioned above.

[0013] As for an electrode, in this invention, it is desirable to have further the 3rd electrode layer for suppressing oxidization of Cu formed on the 2nd electrode layer.

[0014] More preferably, the 3rd above-mentioned electrode layer is formed so that the 2nd upper surface and side of an electrode layer may be covered. In this case, as for the 3rd electrode layer, being formed by the sputtering method is desirable.

[0015] Moreover, when it has the above-mentioned 1st or the 3rd electrode layer as an electrode, as for the thickness of the 2nd electrode layer, it is desirable to consider as 40% or more of total thickness Mino of an electrode and 80% or less.

[0016] In addition, the 3rd electrode layer consists of alloys which make a principal component preferably the alloy, Au, or this which makes aluminum or this a principal component.

[0017]

[Embodiments of the Invention] Drawing 1 is the cross section showing a part of

surface acoustic element 1 by 1 operation form of this invention, and shows the portion by which the electrode 3 was formed on the piezo-electric substrate 2.
[0018] The piezo-electric substrate 2 is LiTaO3. Or LiNbO3 It consists of single crystals.
[0019] Moreover, the electrode 3 is equipped with the 1st electrode layer 4 formed on the piezo-electric substrate 2, the 2nd electrode layer 5 formed on the 1st electrode layer 4, and the 3rd electrode layer 6 formed on the 2nd electrode layer 5.

[0020] The 1st electrode layer 4 consists of Ti or a Ti alloy, for example, is formed of a vacuum deposition. The 2nd electrode layer 5 consists of Cu or a Cu alloy, for example, is formed of a vacuum deposition.
[0021] Thus, the adhesion to the piezo-electric substrate 2 of the 2nd electrode layer 5 can be raised by forming first the 1st electrode layer 4 which consists of Ti or a Ti alloy on the piezo-electric substrate 2 as the ground layer in forming the 2nd electrode layer 5 which consists of Cu or a Cu alloy. Moreover, by forming the 2nd electrode layer 5 which consists of Cu or a Cu alloy on the 1st electrode layer 4 which consists of Ti or a Ti alloy, the crystal stacking tendency in this 2nd electrode layer 5 can improve, and power-proof nature can be raised.
[0022] The 3rd electrode layer 6 is formed if needed, in order to suppress oxidization of Cu contained in the 2nd electrode layer 5, and it consists of alloys which make a principal component the alloy, Au, or this which makes aluminum or this a principal component. In order to attain the purpose of the formation more perfectly, as shown in drawing 1 , as for the 3rd electrode layer 6, it is desirable to be formed so that the 2nd upper surface and side of the electrode layer 5 may be covered. In order to form the 3rd electrode layer 6 with such a formation mode, it is desirable to apply the sputtering method.
[0023] About the thickness of such an electrode 3, as an example, the 1st electrode layer 4 is set to 10nm, the 2nd electrode layer 5 is set to 60nm, and the 3rd electrode layer 6 is set to 30nm. That is, thickness of the 2nd electrode layer 5 is made into 60% of total thickness Mino of an electrode 3. When the oxidization depressant action of Cu by improvement in the adhesion between the 2nd electrode layer 5 and the piezo-electric substrates 2 by the 1st electrode layer 4 which was mentioned above, the improvement in the power-proof nature by the 2nd electrode layer 5, and the 3rd electrode layer 6 is taken into consideration, as for the thickness of the 2nd electrode layer 5, it is desirable to consider as 40% or more of total thickness Mino of an electrode 3 and 80% or less.
[0024] Drawing 2 shows the typical process included in the manufacture method of a surface acoustic element 1 shown in drawing 1 , especially the formation method of an electrode 3 one by one.
[0025] First, subsequently, the resist which consists of an optical reactivity resin is applied on the piezo-electric substrate 2, and a resist is exposed by using the optical shield describing the desired electrode pattern as a mask, and after that, as a resist is developed with a developer and it is shown in drawing 2 (1), the resist pattern 7 is formed on the piezo-electric substrate 2. In this resist pattern 7, the amount of opening is making the back taper-like cross-section configuration.
[0026] Next, from the upper part of the resist pattern 7, by the vacuum deposition,

the 1st electrode layer 4 is formed and the 2nd electrode layer 5 is formed succeedingly. In addition, although it is not essential, when a film 8 is formed on the resist pattern 7 from the same material as it when forming the 1st electrode layer 4, and forming the 2nd electrode layer 5, the film 9 which consists of the same material as it is formed on the above-mentioned film 8.

[0027] Next, from the upper part of the resist pattern 7, by applying the sputtering method, for example on conditions with a membrane formation pressure of 0.01Pa or more, the 3rd electrode layer 6 is formed so that the 2nd electrode layer 5 may be covered. Although it is not essential at this time, the film 10 which consists of the same material as the material which constitutes the 3rd electrode layer 6 is formed on the film 9 mentioned above.

[0028] Then, the resist pattern 7 is flooded with resist exfoliation liquid. Since the resist pattern 7 dissolves in exfoliation liquid, the lift off of it is carried out from the piezo-electric substrate 2 by this. Thus, the surface acoustic element 1 as shown in drawing 1 is obtained.

[0029]

[Effect of the Invention] As mentioned above, after forming the 1st electrode layer which consists of Ti or a Ti alloy on a piezo-electric substrate as an electrode formed on a piezo-electric substrate according to this invention Since the 2nd electrode layer which consists of Cu or a Cu alloy is formed, while being able to raise the adhesion to the piezo-electric substrate of the 2nd electrode layer, the surface acoustic element which should be excellent in the crystal stacking tendency in the 2nd electrode layer, therefore was excellent in power-proof nature can be obtained.

[0030] Therefore, property degradation of an electric short circuit, the increase in an insertion loss, Q fall of a resonator, etc. can be made hard to be able to make destruction of the electrode by the stress migration hard to produce, and to cause, although detailed-ization of the pattern width of face of an IDT electrode progresses with RF-izing even if a surface acoustic element is turned to the use as which high power-proof nature like for example, an antenna duplexer is required and. moreover, for example, the time of wirebonding -- an electrode -- separating -- being hard -- therefore, the number of processes for newly not preparing the pad for wirebonding, consequently obtaining a surface acoustic element can be lessened, and the cost of a surface acoustic element can be reduced

[0031] In this invention, if the 3rd electrode layer for suppressing oxidization of Cu is formed on the 2nd electrode layer which consists of Cu or a Cu alloy, oxidization of Cu contained in the 2nd electrode layer can be suppressed, and let improvement in the power-proof nature mentioned above be a more positive thing. Moreover, if this 3rd electrode layer is formed so that the 2nd upper surface and side of an electrode layer may be covered, the oxidization depressor effect of Cu can be heightened further.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the cross section showing a part of surface acoustic element 1 by 1 operation gestalt of this invention.
[Drawing 2] It is the cross section showing some processes included in the formation method of the electrode 3 in the surface acoustic element 1 shown in drawing 1 in illustration one by one.
[Description of Notations]
1 Surface Acoustic Element
2 Piezo-electric Substrate
3 Electrode
4 1st Electrode Layer
5 2nd Electrode Layer
6 3rd Electrode Layer

[Translation done.]